References

DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
Transportation Laboratory
5900 Folsom Blvd
Sacramento, California 95819-4612

METHOD FOR CALIBRATION OF CALIFORNIA PORTABLE SKID TESTER

CAUTION:	Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read "**SAFETY AND HEALTH**" in Section E of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

A. SCOPE

The Procedure for the direct calibration of the California Portable Skid Tester, which is used in California Test 342, is described in this method.

B. APPARATUS

1. Calibration plate, Grooved metal (Figure 1)

2. Holding plate (Figure 2)

C. CALIBRATION PROCEDURE

1. Anchor the holding plate with hardened nails on a level surface such as an AC driveway.

2. Position the tester over the calibration plate.

3. Block up the large front casters of the tester to the same elevation as the test plate surface.

4. Coat the test plate and test tire with glycerine.

   Note: Temperatures near 4.4° C or less will yield low values because the glycerine loses fluidity.

5. Perform test in both directions on the plate using the procedures outlined in California Test 342. Recoat the plate and tire with glycerine before each test. The desired reading against the cut is 0.42 ± .02 for all plates. Values desired with the cut vary depending upon the plate used. The friction factor of Plate No.1 (Districts 07 and 11) is 0.27, Plate No. 2 (District 04 and the Transportation Laboratory) is 0.30 and Plate No. 3 (Branch Laboratory in Los Angeles) is 0.32. The diagram (Figure 1a) defines with and against the cut.

6. After completing the tester calibration, thoroughly wash the standard plate with warm water and detergent, dry the plate and replace face down in the box.

D. ADJUSTMENT PROCEDURE

1. Adjustments can be made in the tension of the small coil springs.

2. Large discrepancies may be corrected by adding or removing wheel weights.

3. If wheel weights are necessary, maintain a centrifugal balance by applying equal masses across the axle. Do not loosen more that one bolt at a time while changing weights.

Note: Before making large adjustments, investigate the following common sources of problems: dirty vertical support rod; dirty sliding gauge indicators; speedometer error; improper tire pressure, 1.73 kPa (25 psi ± 2 psi); cold glycerine and corroded carriage bearings.

E. SAFETY AND HEALTH

Testers are required to wear face protection due to the presence of glycerin mist, and also to read Chapter 12.15 (Face and Eye Protection) and Chapter 15 (Respiratory Protection) of Caltrans Employee Safety Manual.

REFERENCES
California Test 342
End of Text (4 pages) on Calif. 114

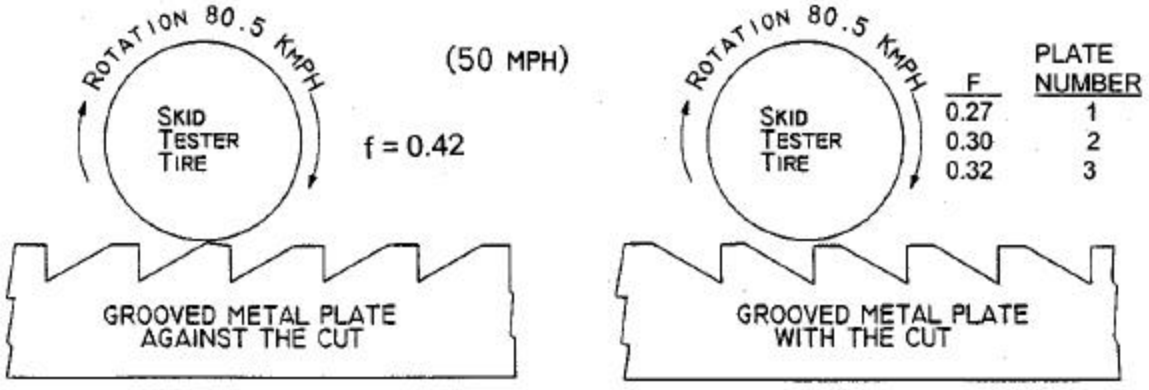
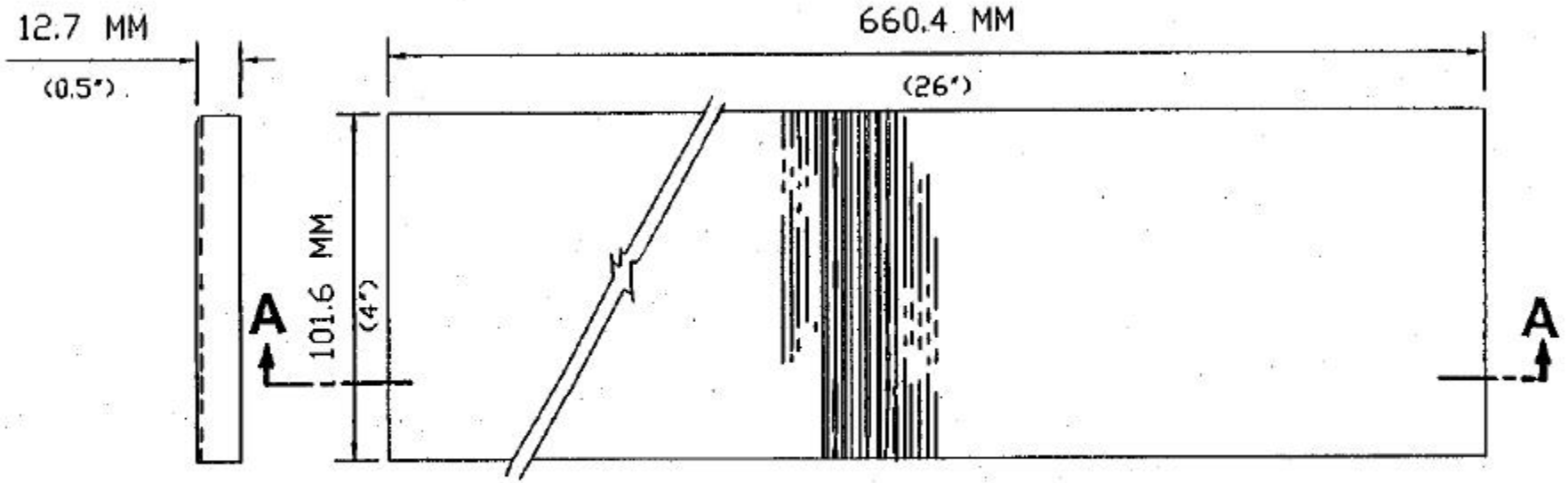
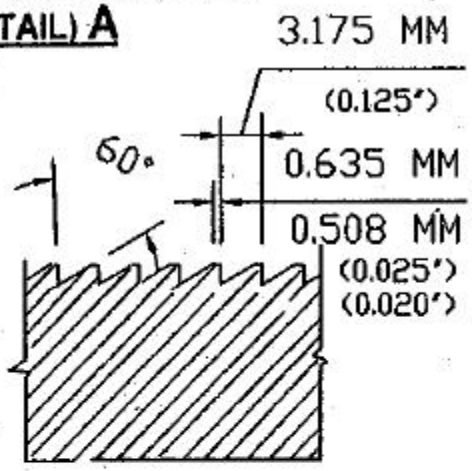

ROTATION 80.5 KMPH
SKID TESTER TIRE
(50 MPH)
f = 0.42
GROOVED METAL PLATE AGAINST THE CUT
ROTATION 80.5 KMPH
SKID TESTER TIRE
F
0.27
0.30
0.32
PLATE NUMBER
1
2
3
GROOVED METAL PLATE WITH THE CUT

Figure 1a



60° MILL CUT
CONTINUOUS THIS SIDE
(SEE DETAIL) A



NOTES:

1. MATL. - AIR HARDENING PRECISION GRND TOOL STL. – AISI – A2
2. HEAT TREAT - 55 – 59 R/C WITHOUT DISTORTION
3. FINISH – REMOVE ALL BURRS BUT LEAVE ALL TOOTH EDGES SHARP.

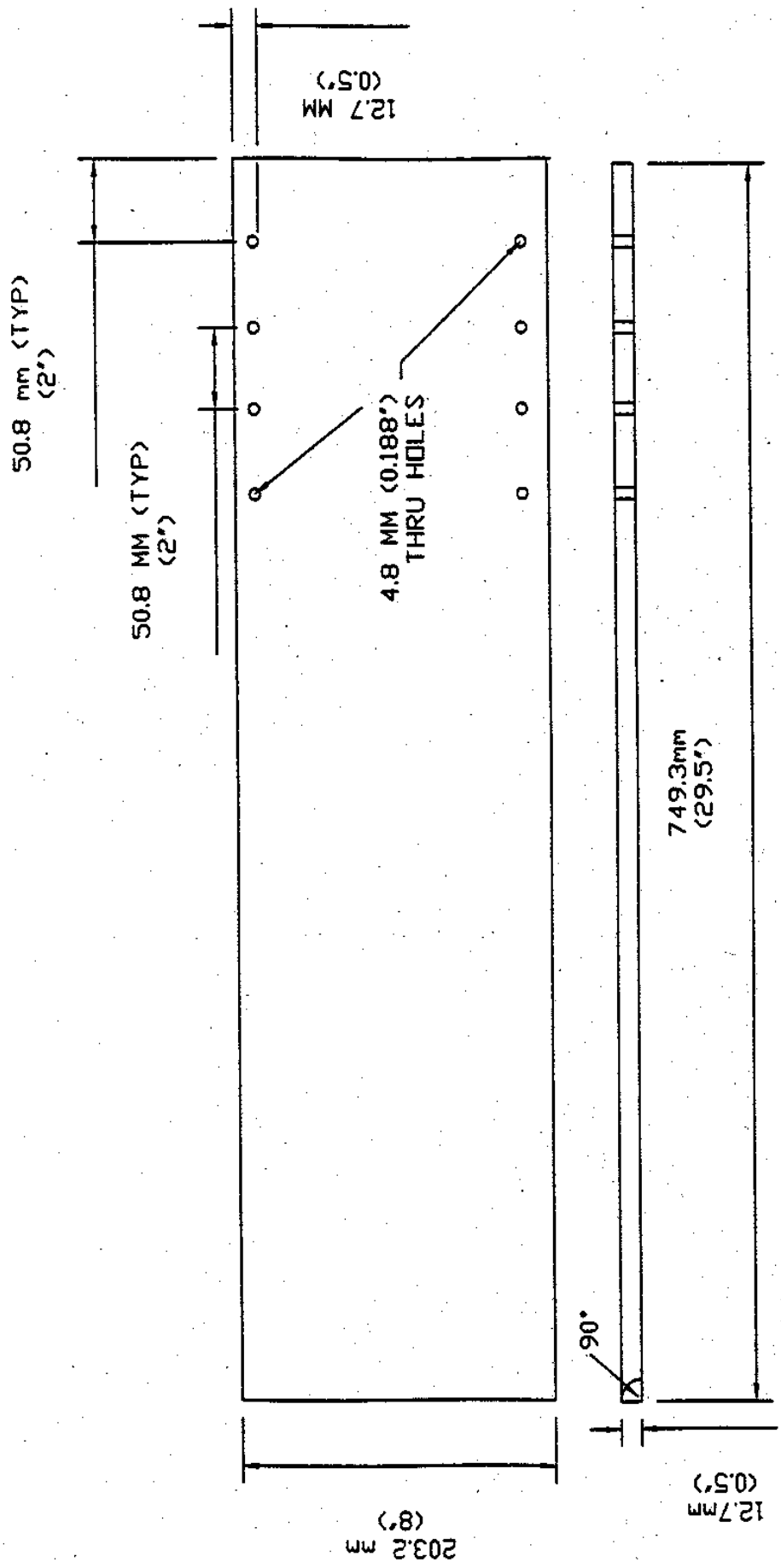
SECTION A-A

MILL CUT DETAIL
SCALE – TWICE SIZE

SKID RESISTANCE STANDARD TEST SURFACES

SCALE – HALF & NOTED

FIGURE 1



NOTE: MATERIALS – 17 GAUGE, GALVANIZED METAL

HOLDING PLATE FOR SKID RESISTANCE STANDARD TEST SURFACES

SCALE 1:4 (1/4" = 1")

FIGURE 2

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY

DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
Transportation Laboratory
P. O. Box 19128
Sacramento, California 95819

METHOD OF TEST FOR SURFACE SKID RESISTANCE WITH THE CALIFORNIA PORTABLE SKID TESTER

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read **"SAFETY AND HEALTH"** in Section H of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

A. SCOPE

The apparatus and procedure for obtaining coefficient of friction values of bituminous and portland cement concrete pavements and bridge decks using a portable skid tester are described in this test method.

B. APPARATUS

1. Skid testing unit

   A 2-ply tire (200 mm rim height, 95 mm rim width, 425 mm tire height and a maximum overall tire width from 100 to 120 mm) with 170 ± 15 kPa air pressure manufactured with a smooth tread, together with rim, axle, and driving pulley, is mounted to a rigid frame. The tire is brought to the required test speed by a motor. A carriage moves on two parallel guides. Friction is reduced to a low uniform value with three roller bearings fitted at 120° points to bear against the guide rod at each corner of the carriage. Two guide rods are rigidly connected to the end frame bars. The front end of the guide bar frame assembly is firmly fastened to a bumper hitch to restrain forward movement. The bumper hitch provides for swinging the skid tester to the right or left after positioning the vehicle. The rear end of the frame assembly is raised by an adjustable knob to hold the tire 6 mm above the surface to be tested. This device is constructed so that the tire may be dropped instantaneously to the test surface by tripping the release arm. A tachometer indicates the speed of the tire in kilometers per hour. The springs are calibrated by procedures outlined in California Test 114. See Figures 1, 2 and 3.

2. A trailer hitch is used to fasten the skid testing unit to the test vehicle.

3. A 0.7-m metal carpenter's level, fitted at one end with a movable gage rod, is required. This device is calibrated to determine surface grades, in percent.

C. MATERIALS

1. Glycerin

2. Water

3. Paint brush
   (approximately 50 mm wide)

4. Wooden spacer
   (6 mm thick, 0.6 m long and 25 mm wide)

5. A stiff fiber broom

D. TEST PROCEDURE

1. Clean loose material from the test surface using the stiff fiber broom.

2. Determine the grade of the test surface.

   a. Place the metal level on the test surface parallel to direction of traffic with the adjustable end down grade.

   b. Adjust the level until the bubble is centered.

   c. The grade is read directly on the calibrated sliding bar. See Figure 4. Record this slope to nearest 0.5 %.

3. Remove the skid testing unit from the vehicle, attach it to the bumper hitch, and connect the power cables as shown in Figure 5.

4. Position the skid tester with the test tire over the pavement surface to be tested. The test tire should be parallel to the direction of traffic.

5. Place the wooden spacer under the test tire and turn the adjustment knob to obtain a distance of 6 mm from the test surface to the bottom of the test tire. Remove the wooden spacer.

6. Wet the full circumference of the test tire and the test surface (from the initial tire contact point to approximately 0.5 m ahead of the contact point) with glycerin, using the paint brush.

7. Release the rebound shock absorber. This device is located in front of the switch, and below the motor.

8. Set the sliding gage indicator against the carriage end.

9. Depress the starting switch and bring the test tire speed to approximately 90 km / h.

10. Release starting switch.

11. Drop the test tire to the pavement surface the instant the tachometer shows 80 km / h. This is performed by engaging the lever arm.

12. Read the gage at the rear edge of indicator and record the test measurement. Obtain a coefficient of friction value for the smoothest appearing surface or surfaces on the project.

    For a pavement surface, obtain five test measurements and report the average as the coefficient of friction. Make the tests in a longitudinal direction at 7.5-m intervals, unless any test measurement is less than the specified minimum. If less than the specified minimum, make five test measurements at 0.6-m intervals within or including the smoothest appearing area.

    For a bridge deck, obtain the coefficient of friction value by averaging three test measurements. Space each test location for this average no nearer than 0.6 m nor farther than 1.2 m, from any other test location. The spacing may be lateral or longitudinal, but perform the test measurement in a longitudinal direction.

    For coefficient of friction values less than the specified minimum, use a combination of visual observations and individual test measurements to define the area of non-compliance.

E. CALCULATIONS

1. Make pavement corrections due to slope changes using Figures 6 and 7.

2. Average the corrected readings for each test location.

Example: The following readings were taken at 7.5 m intervals in a test location.

Test Location	Test Measurement	% Grade	Corrected Test Measurement*
0+00.0	0.37	+2	0.39
0+07.5	0.38	+1	0.39
0+15.0	0.40	+1	0.41
0+22.5	0.39	+1	0.40
0+30.0	0.41	+1	0.42
Average Coefficient of Friction =			0.40

*Corrected values for upgrade measurements were taken from chart in Figure 6.

Examples of coefficient of friction values for different pavement textures are presented in the Appendix.

F. PRECAUTIONS

1. The rear support rod must be cleaned by washing frequently with water and a detergent to prevent sticking. A coating of light oil should be applied.

2. Sliding gage indicator must be kept clean so that it will slide very freely, and adjusted so that it will not shift upon carriage recoil impact.

3. Glycerin remaining on the surface after the test should be flushed off with water.

4. A minimum of seven days should lapse after PCC placement before testing.

5. A minimum of one day should lapse after AC placement before testing.

6. Temperatures less than 4.5˚C will cause glycerin to become viscous and yield lower values. For full accuracy, coefficient of friction values must be obtained at temperatures greater than 4.5˚C.

7. At the conclusion of a testing period, thoroughly wash the entire tester with water and carefully dry all parts with a cloth to minimize the corrosive properties of glycerin.

8. Use care when removing and reinserting the test apparatus in the transport vehicle. See Figures 8 and 9.

G. REPORTING OF RESULTS

The report shall include the following data:

1. The name of the tester and the date when test measurements were recorded

2. The contract number

3. The year when the pavement surface was placed

4. The location of the test measurements

5. The surface grade for each test site

6. The initial and corrected test measurements and the average coefficient of friction value for each test location

7. Average air temperature during testing

8. Form TL-3111 shall be used to report all test results. See Figure 10.

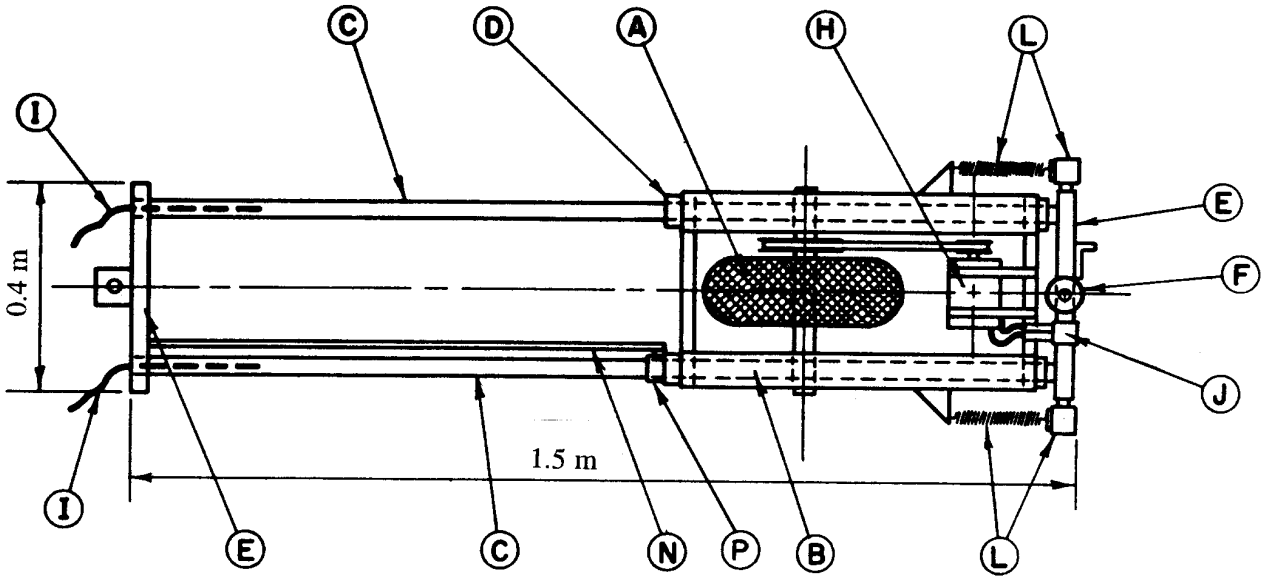
H. SAFETY AND HEALTH

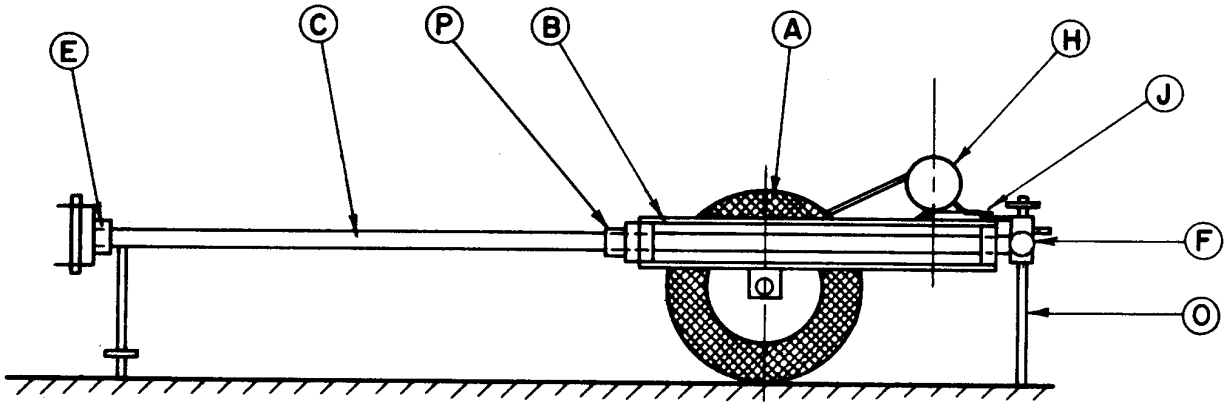
Prior to handling, testing or disposing of any waste materials, testers are required to read: Part A (Section 5.0), Part B (Sections: 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans Laboratory Safety Manual. Users of this method do so at their own risk.

REFERENCE:

California Test 114

End of Text (California Test 342 contains 12 pages)





LETTER REFERENCE	DESCRIPTION
A	TEST TIRE
B	CARRIAGE COLLAR
C	CARRIAGE GUIDE RODS
D	BEARING ASSEMBLY
E	END FRAME BARS
F	ADJUSTMENT KNOB
G	RELEASE ARM
H	MOTOR
I	POWER CABLES
J	STARTING SWITCH
K	TACHOMETER
L	CALIBRATED SPRINGS
M	TIRE CIRCUMFERENCE
N	GAGE
O	REAR SUPPORT ROD
P	SLIDING GAGE INDICATOR

FIGURE 1 - DIAGRAM OF SKID TESTER

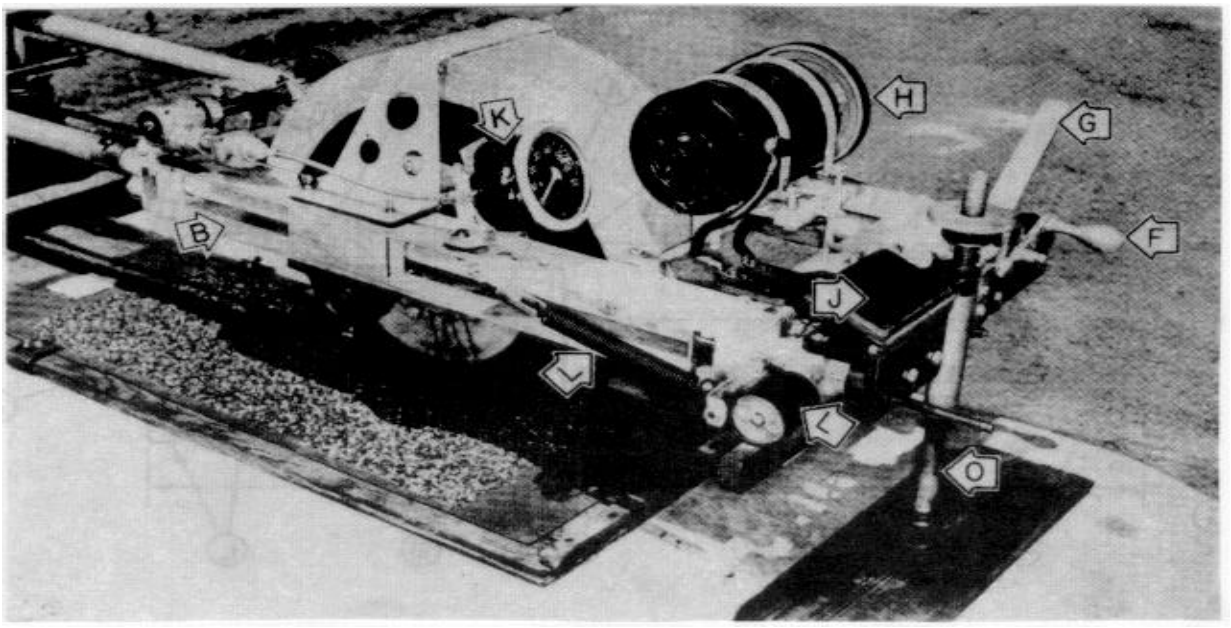
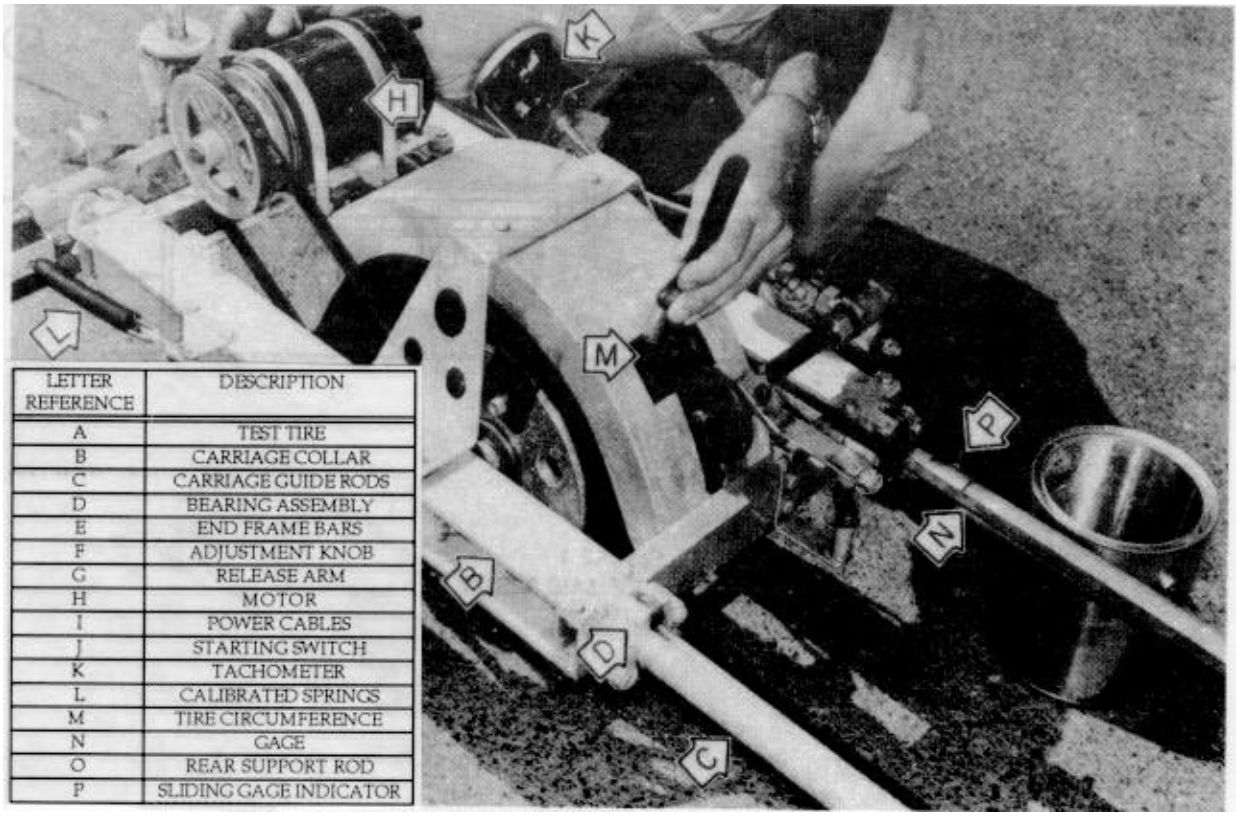


FIGURE 2 - SIDE VIEW OF SKID TESTER



LETTER REFERENCE	DESCRIPTION
A	TEST TIRE
B	CARRIAGE COLLAR
C	CARRIAGE GUIDE RODS
D	BEARING ASSEMBLY
E	END FRAME BARS
F	ADJUSTMENT KNOB
G	RELEASE ARM
H	MOTOR
I	POWER CABLES
J	STARTING SWITCH
K	TACHOMETER
L	CALIBRATED SPRINGS
M	TIRE CIRCUMFERENCE
N	GAGE
O	REAR SUPPORT ROD
P	SLIDING GAGE INDICATOR

FIGURE 3 - CLOSE-UP VIEW OF SKID TESTER

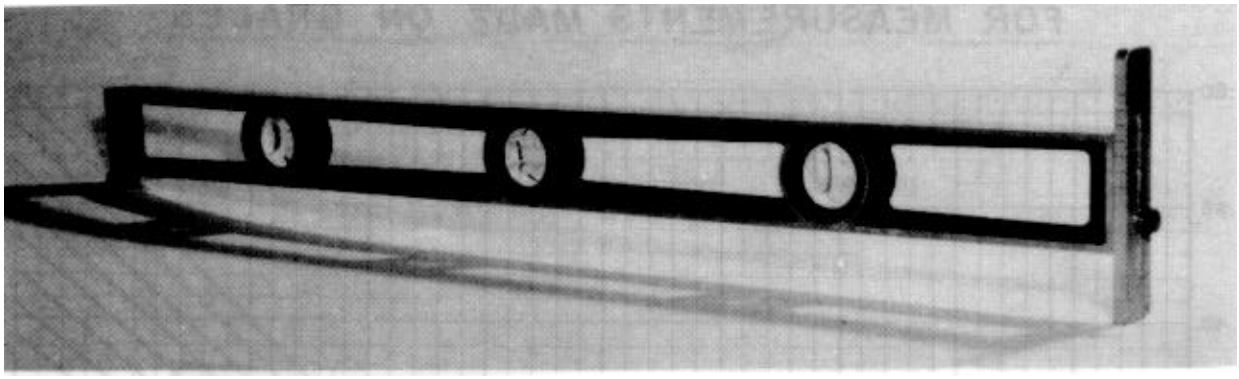


FIGURE 4 - LEVEL FOR MEASURING PAVEMENT SLOPE

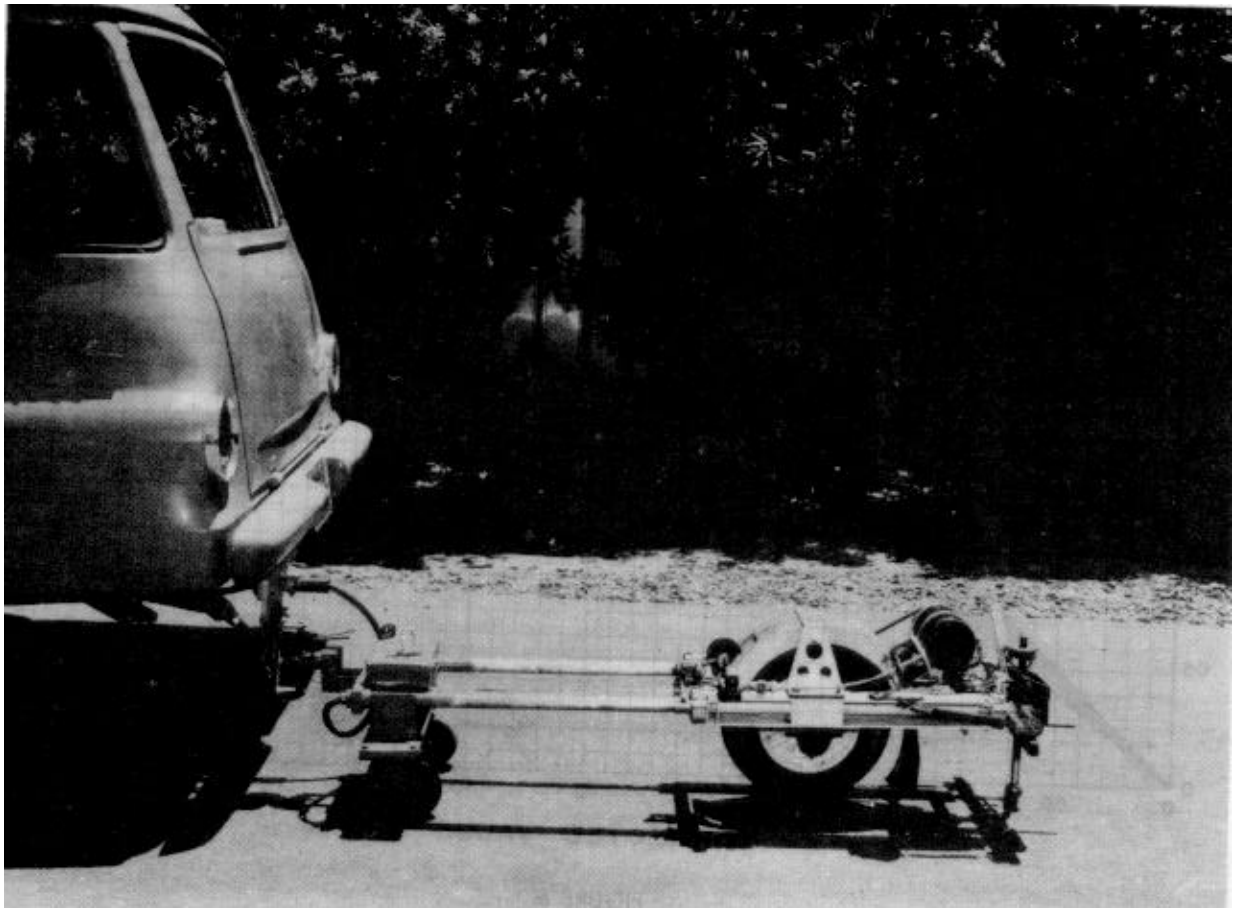


FIGURE 5 - APPARATUS IN TEST POSITION

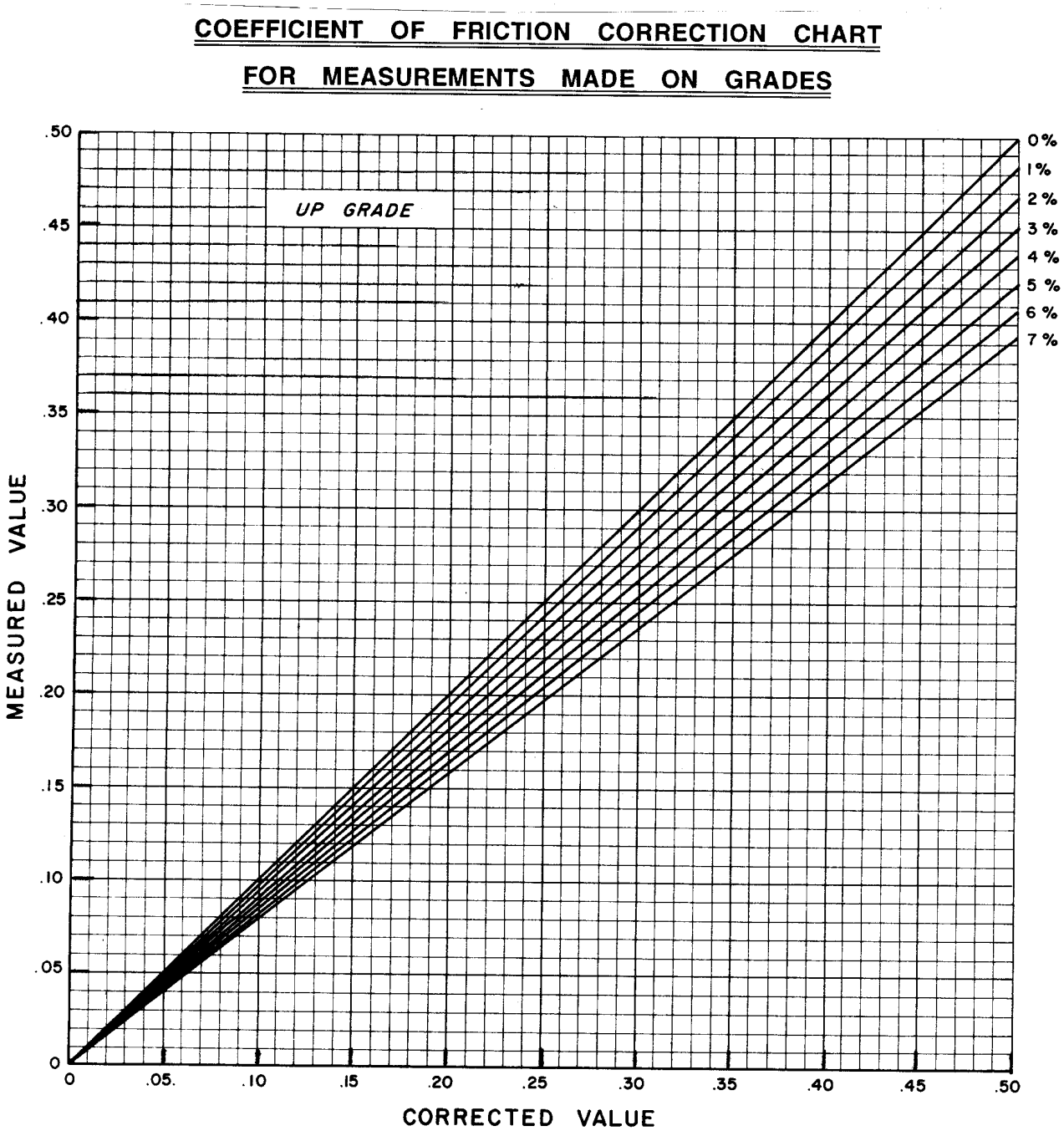


FIGURE 6 - GRADE CORRECTION CHART (UP GRADE)

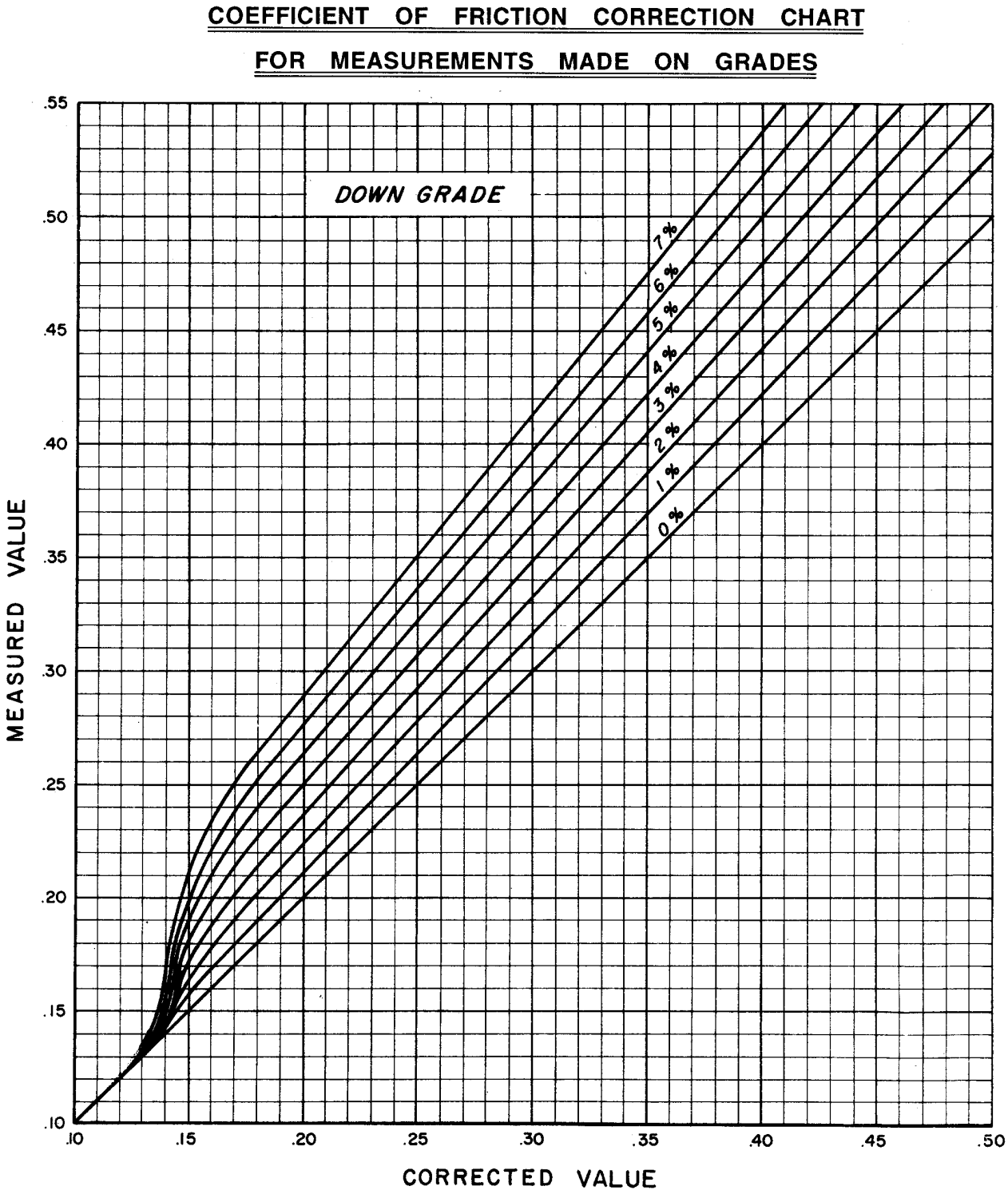


FIGURE 7 - GRADE CORRECTION CHART (DOWN GRADE)

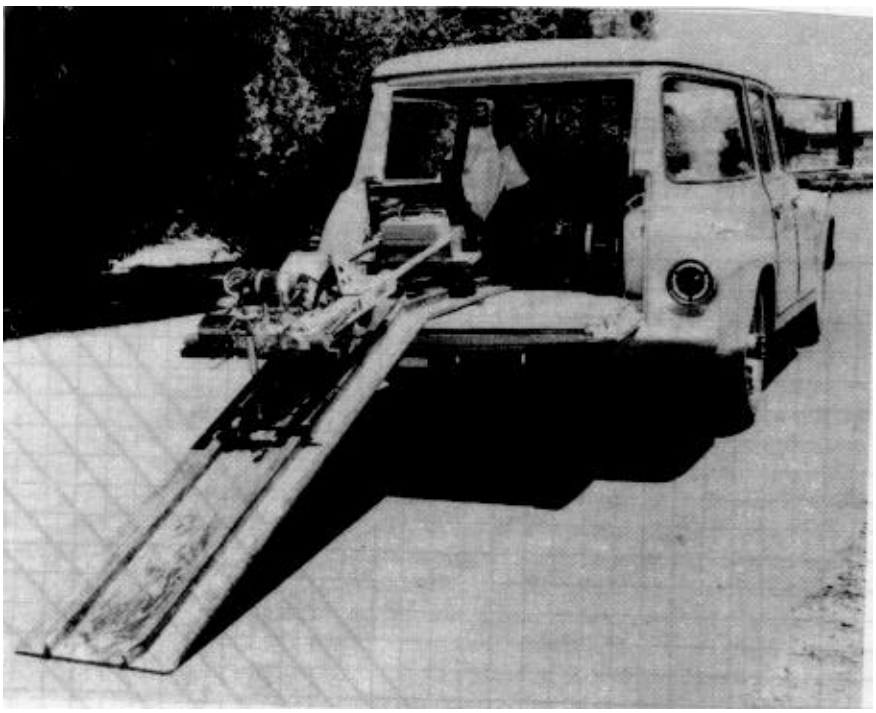


FIGURE 8 - APPARATUS BEING PLACED IN VEHICLE
(NOTE: CABLE AND WINCH FOR MOVING SKID TESTER)

FIGURE 9 - APPARATUS IN POSITION FOR TRANSPORTING

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER

TRANSPORTATION LABORATORY
REPORT OF SKID TESTS

DISTRIBUTION
_ TRANSLAB
_ RESIDENT ENGINEER
_ DISTRICT MATERIALS ENGINEER
_ OFFICE OF STRUCTURES

District, County, Route, P.M. _____

Contract Number _____ Number of Lanes _____

Federal Number _____ Bridge Width _____

Contract Limits _____

Tested By _____ Test Date _____ Bridge No. _____

Lane: _____ Average Air Temperature _____

Position: In the direction of flow, position denotes feet to the right of the left edge of pavement or the inside face of the right wheel from the left bridge rail.

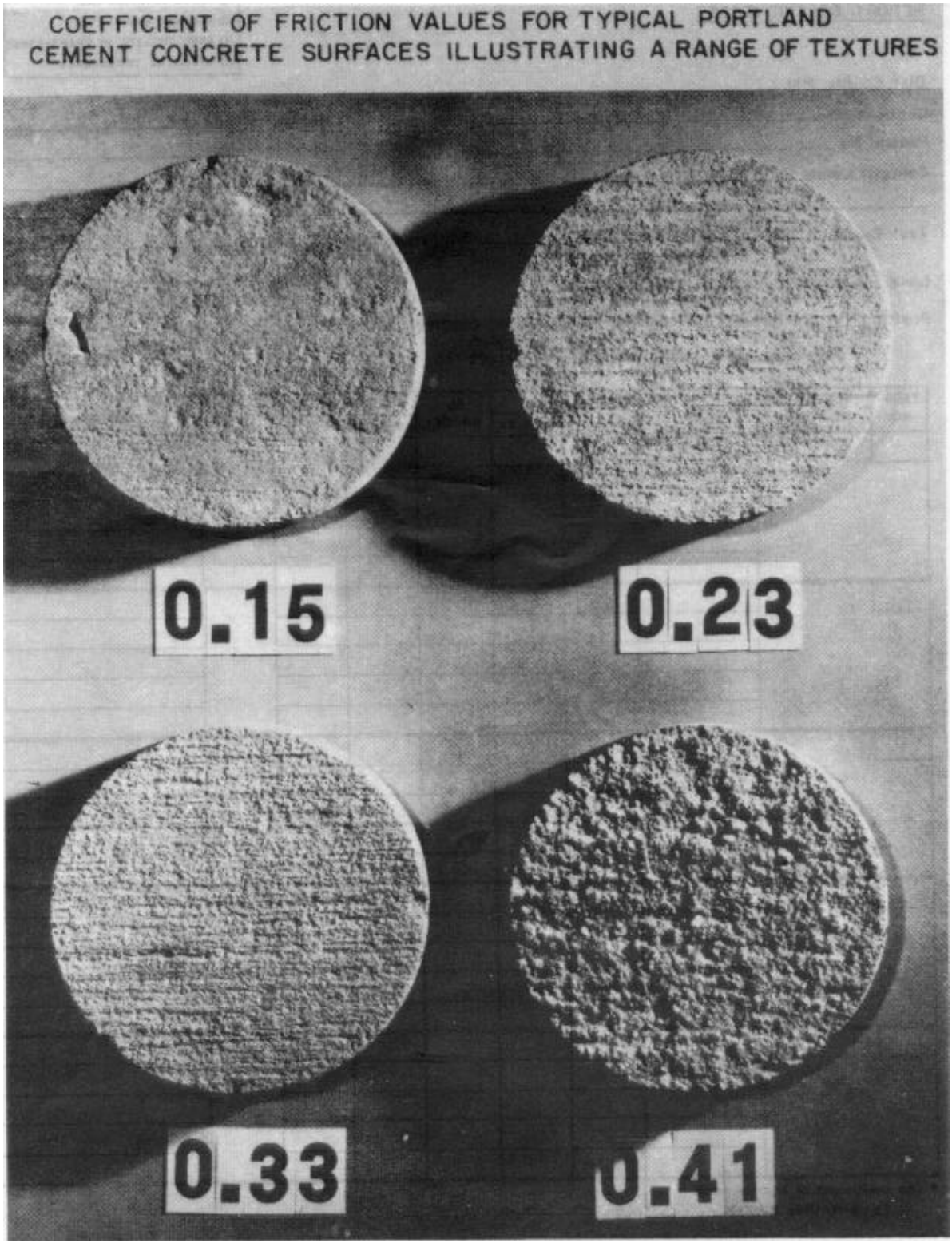
TEST NO.	DATE PLACED	LOCATION			PERCENT GRADE	TEST MEASUREMENT			REMARKS
		KILOMETER POST	LANE	POSITION		MEASURED	CORRECTED	AVERAGE *	
1									
2									
3									
4									
5									

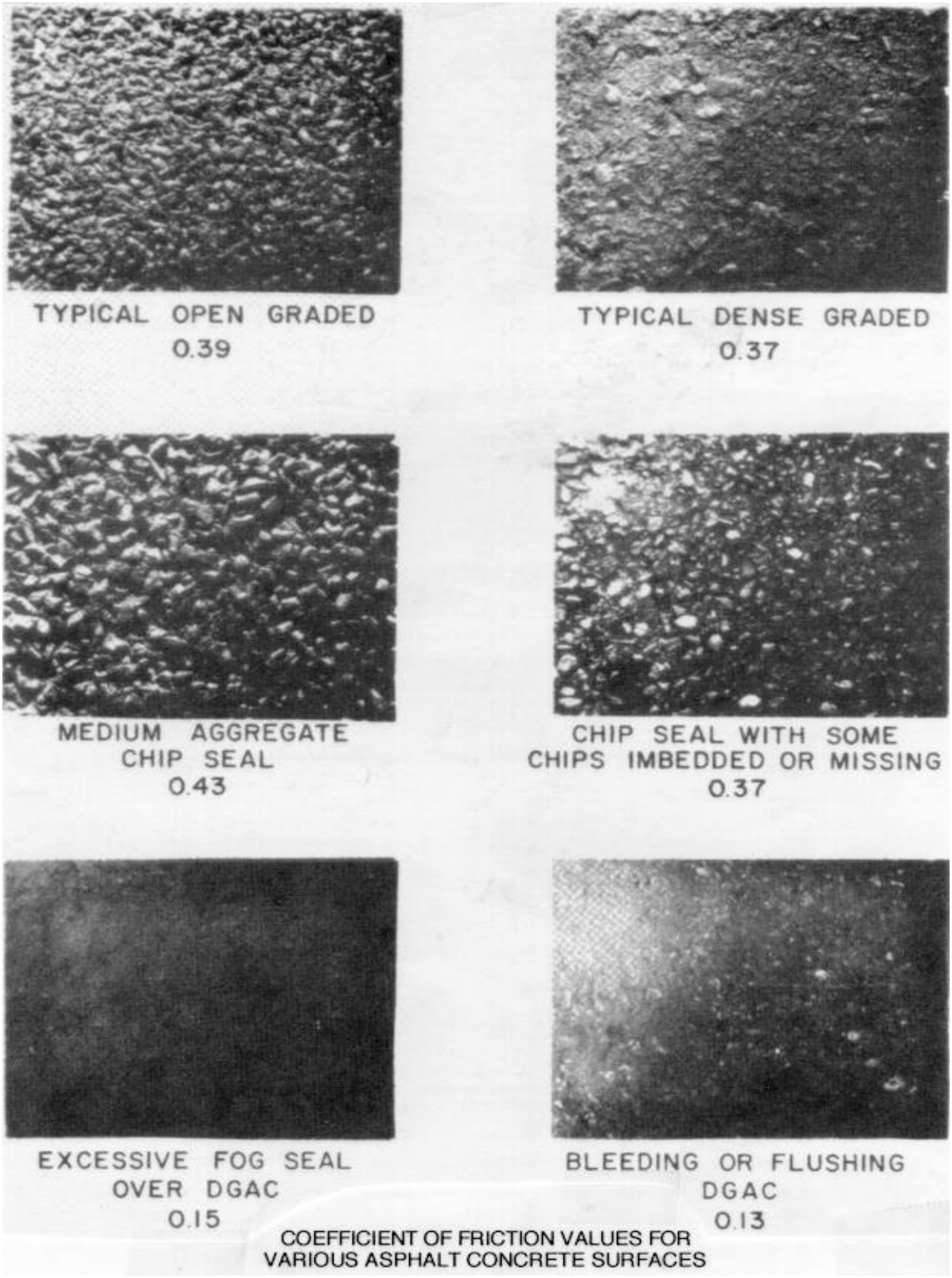
* The coefficient of friction value

FORM TL-3111 (Revised 8/95)

FIGURE 10 - REPORT FORM

APPENDIX


COEFFICIENT OF FRICTION VALUES FOR TYPICAL PORTLAND CEMENT CONCRETE SURFACES ILLUSTRATING A RANGE OF TEXTURES
0.15
0.23
0.33
0.41



COEFFICIENT OF FRICTION VALUES FOR
VARIOUS ASPHALT CONCRETE SURFACES

STATE OF CALIFORNIA · DEPARTMENT OF TRANSPORTATION

ENCROACHMENT PERMIT FEE SCHEDULE

TR-0166 (REV. 05/03)

CODE	PERMIT TYPE	REVIEW HOURS (3)	INSPECTION HOURS (3)
GENERAL			
AD ---	Advertising Displays, Marquees, Memorial/Historical Plaques, Blue Star Memorial Markers, Arcades, Awnings	AX	AX
AH ---	Adopt – A – Highway ' Travelway '	EXEMPT	EXEMPT
AP ---	Art Program	EXEMPT	EXEMPT
AS ---	Airspace Development	AX	AX
BR ---	Banners / Decorations / Signs	1	1
BS ---	Bus Shelters & Benches	EXEMPT	AX
CC ---	City / County Issued Permits	----------	----------
CD ---	Commercial Development	AX	AX
CN ---	Chain Installer	2 + Bib	AX
CS ---	Curb / Gutter / Sidewalk	AX	AX
CU ---	Coupon Racks & Newspaper Vending Machines @ Roadside Rests	AX (4)	AX (4)
CU ---	Adopt-A-Kiosk (TSIC)	EXEMPT (5)	EXEMPT (5)
CU ---	Roadside Rest Vending Machines	EXEMPT	EXEMPT
DP ---	Double Permit -	1	Per Original
	Cooperative Agreements or State Service Contracts	EXEMPT (3)	EXEMPT (3)
FN	Fence - New / Modified	AX	AX
MB ---	Mail Box	EXEMPT	EXEMPT
MC ---	Contractor's Yard & Plant, Grading, Fire Protection Signs, Guide Signs, Mowing Grass, Material Removal, Structures, Parking Meters, Tieback Widening- Fwy & Conv, Striping	AX	AX
OA ---	Visibility Improvement Request	AX	AX
RX ---	Rail Road Crossing	EXEMPT	EXEMPT
SC ---	State Contract – Early Entry	1	0
SV ---	Land Survey, Archaeological Survey, Traffic Counts, Research Project, Accident Reconstruction, Literature Distribution, Monitoring Wells	AX	AX
TN ---	Tunneling Under Road (30 "+)	AX	AX
WL ---	Wall	AX	AX
DRAINAGE			
DM ---	Minor Drainage	AX	AX
DD ---	Major Drainage	AX	AX
FILMING			
FI ---	Intermittent Traffic Control	2	0
FL ---	Traffic Control	AX	AX
FO ---	No Moving Traffic	1	0
FR ---	Film Rider	AX	AX
FS ---	Special	AX	AX

CODE	PERMIT TYPE	REVIEW HOURS (3)	INSPECTION HOURS (3)
GEO-PHYSICAL TESTING			
GC --	Cable Crossing	AX	AX
GV --	Seismic Vibrator	AX	AX
LANDSCAPE			
LC --	Conventional Highway	AX	AX
LF --	Freeway	AX	AX
LM -	Maintenance	AX	AX
LT --	Tree Trim / Removal	AX	AX
RIDER			
RD --	Caltrans Initiated Rider	EXEMPT	EXEMPT
RT --	Time Extension Rider	1	AX
RW--	Modify Work Rider	AX	AX
ROAD APPROACH / DRIVEWAY			
RC --	Commercial	AX	AX
RM -	RE - surface, issue, construct	1	AX
RP --	Public / Private	AX	AX
RS --	Single Family / Agricultural	AX	AX
SPECIAL EVENT			
SE ---	Special Event	AX	AX
SIGNALS / LIGHTING			
SN	Signal - New / Modify	AX	AX
TK --	Traff. Cntrl, Signals, Lighting	AX	AX
ANNUAL / BI - ANNUAL			
--- ---	ALL PERMITS	2	AX
UTILITIES			
UB --	Utilities; In or On a Bridge	AX	AX
UM--	Biennial/Annual Maintenance	AX	AX
UC --	Conventional Aerial	AX	AX
UE --	Biennial/Annual Utility & Service	AX	AX
UF --	Freeway Aerial	AX	AX
UK --	Underground Long. Major	AX	AX
UL --	Underground Long. Minor	AX	AX
UR --	State Required Relocation	EXEMPT	EXEMPT
US --	Service / Pothole / Modify	AX	AX
UJ --	Transverse Bore & Jack	AX	AX
UT --	Open Cut Road	AX	AX
UX --	Trenching & Shoring	AX	AX

Notes:

(1) Public Corporations are EXEMPT from this schedule, but not their contractor's.

(2) Permit Charge Codes; AX and Set Fees may be changed by the District Permit Engineer.

(3) Inspection time will be charged in ONLY one, the Original Permit or the "DP", not in both.

(4) These Racks are NOT covered under a re-imbursement contract between Dept. of Rehabilitation and Caltrans.

(5) Adopt-A-Highway Program "Adopt-A-Kiosk" 'Travel Service Information Services' – Maintenance of Kiosk's in Roadside Rest Areas.

AX A REASONABLE DEPOSIT IS REQUIRED. Collection of actual review fees and a deposit for inspection fees are required before issuance of the permit. Actual inspection fees shall be collected as costs are incurred during the project or upon completion of the project, before release of the bond.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

Greg W. Edwards No. C36386 Exp. 6-30-06 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

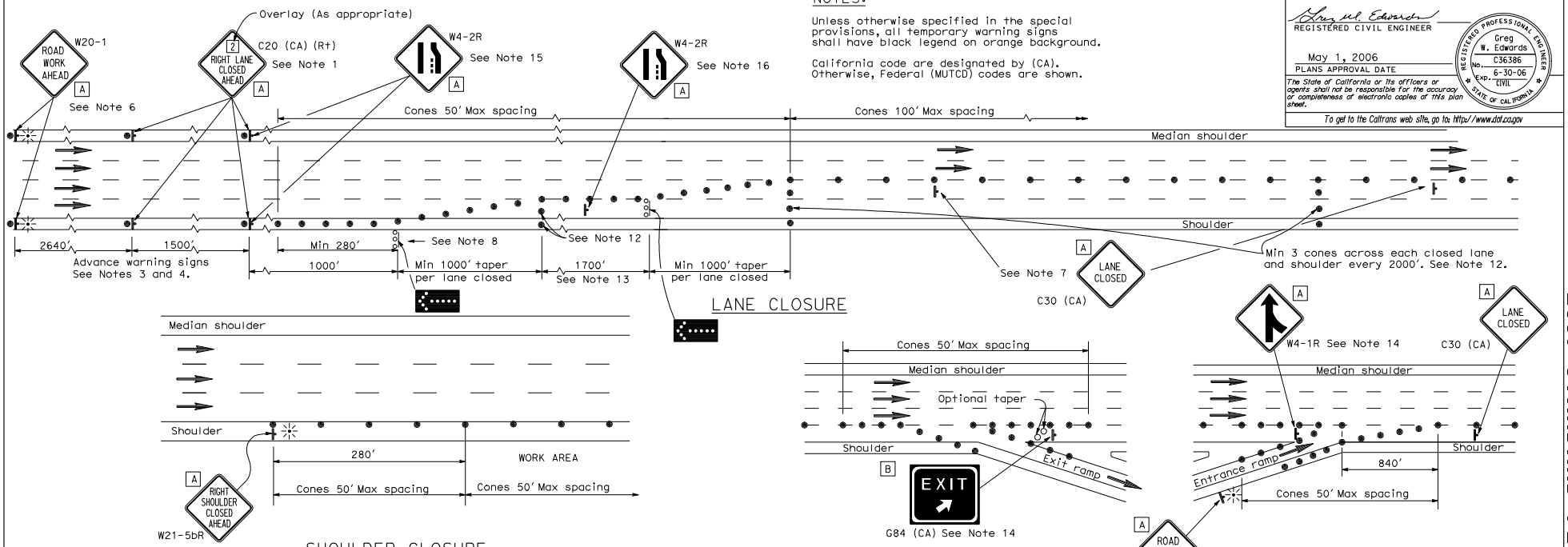
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

To get to the Caltrans web site, go to: http://www.dot.ca.gov

NOTES:

Unless otherwise specified in the special provisions, all temporary warning signs shall have black legend on orange background.

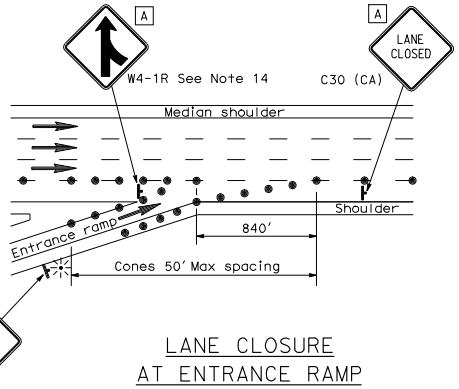
California code are designated by (CA). Otherwise, Federal (MUTCD) codes are shown.



LANE CLOSURE

SHOULDER CLOSURE

LANE CLOSURE AT EXIT RAMP



LANE CLOSURE AT ENTRANCE RAMP

NOTES:

1. Median lane closures shall conform to the details for outside lane closures except that C20 (CA) (Lt) signs shall be used.
2. At least one person shall be assigned to provide full time maintenance of traffic control devices for lane closures.
3. Duplicate sign installations are not required:
   a) On opposite shoulder if at least one-half of the available lanes remain open to traffic.
   b) In the median if the width of the median shoulder is less than 8′ and the outside lanes are to be closed.
4. Each advance warning sign on each side of the roadway shall be equipped with at least two flags for daytime closure. Each flag shall be at least 16" x 16" in size and shall be orange or fluorescent red-orange in color. Flashing beacons shall be placed at the locations indicated for lane closure during hours of darkness.
5. A C14 (CA) "END ROAD WORK" sign, as appropriate, shall be placed at the end of the lane closure unless the end of work area is obvious or ends within a larger project's limits.
6. If the W20-1 sign would follow within 2000′ of a stationary W20-1 or C11 (CA) "ROAD WORK NEXT _____ MILES", use a C20 (CA) sign for the first advance warning sign.
7. Place a C30 (CA) sign every 2000′ throughout length of lane closure.
8. One flashing arrow sign for each lane closed. The first flashing arrow sign shall be Type I. All others may be either Type I or Type II.
9. A minimum 1500′ of sight distance shall be provided where possible for vehicles approaching the first flashing arrow sign. Lane closures shall not begin at top of crest vertical curve or on a horizontal curve.
10. All cones used for lane closures during the hours of darkness shall be fitted with retroreflective bands (or sleeves) as specified in the specifications.
11. Portable delineators, placed at one-half the spacing indicated for traffic cones may be used instead of cones for daytime closures only.
12. Unless otherwise specified in the special provisions, a minimum of 3 cones shall be placed transversely across each closed lane and shoulder at each location where a taper across a traffic lane ends and every 2000′ as shown on the "Lane Closure" detail. Two Type II barricades may be used instead of the 3 cones. The transverse alignment of the cones or barricades on the closed shoulder may be shifted from the transverse alignment to provide access to the work.
13. Unless otherwise specified in the special provisions, the 1700′ tangent shown along lane lines shall be used between the 1000′ tapers required for each closed traffic lane.
14. Unless otherwise specified in the special provisions, the G84 (CA) and W4-1 signs shall be used as shown.
15. When specified in the special provisions, a W4-2 "LANE ENDS" symbol sign is to be used in place of the C20 (CA) "RIGHT LANE CLOSED AHEAD" sign.
16. The W4-2 "LANE ENDS" symbol sign shown at this location is to be used where the W4-2 sign is used as advance warning as described in Note 15.

SIGN PANEL SIZE (Min)

A	48" x 48"
B	54" x 48"

LEGEND

●	Traffic Cone
○	Traffic Cone (optional taper)
	Temporary Sign
	Flashing Arrow Sign (FAS)
	FAS Support or Trailer
	Direction of Travel
	Portable Flashing Beacon

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE ON FREEWAYS AND EXPRESSWAYS

NO SCALE

T10

10-3-05

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — G.W. Edwards — No. C36386 — Exp. 6-30-06 CIVIL — STATE OF CALIFORNIA

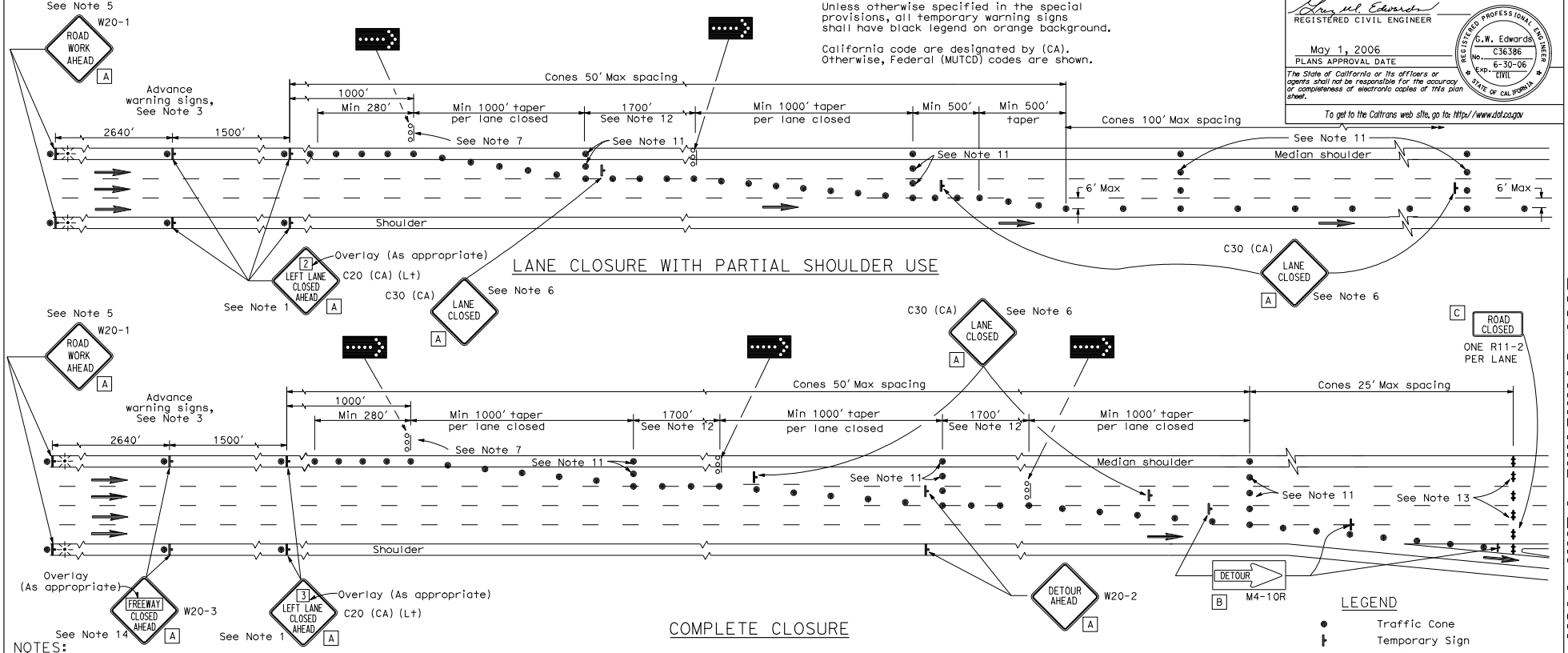
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

To get to the Caltrans web site, go to: http://www.dot.ca.gov

NOTES:

Unless otherwise specified in the special provisions, all temporary warning signs shall have black legend on orange background.

California code are designated by (CA). Otherwise, Federal (MUTCD) codes are shown.



NOTES:

1. Lane closures on the right side using partial median shoulder as a traffic lane shall conform to the details for inside lane closure except that C20 (CA) (Rt) signs shall be used.
2. At least one person shall be assigned to provide full time maintenance of traffic control devices for lane closures.
3. Each advance warning sign on each side of the roadway shall be equipped with at least two flags for daytime closure. Each flag shall be at least 16" X 16" in size and shall be orange or fluorescent red-orange in color. Flashing beacons shall be placed at the locations indicated for lane closure during hours of darkness.
4. A C14 (CA) "END ROAD WORK" sign, as appropriate, shall be placed at the end of the lane closure unless the end of work area is obvious or ends within a larger project's limits.
5. If the W20-1 sign would follow within 2000' of a stationary W20-1 or C11 (CA) "ROAD WORK NEXT ___MILES", use a C20 (CA) sign for the first advance warning sign.
6. Place a C30 (CA) sign every 2000' throughout length of lane closure.
7. One flashing arrow sign for each lane closed. The first flashing arrow sign shall be Type I. All others may be either Type I or Type II.
8. A minimum 1500' of sight distance shall be provided where possible for vehicles approaching the first flashing arrow sign. Lane closures shall not begin at the top of crest vertical curve or on a horizontal curve.
9. All cones used for lane closures during the hours of darkness shall be fitted with retroreflective bands (or sleeves) as specified in the specifications.
10. Portable delineators, placed at one-half the spacing indicated for traffic cones, may be used instead of cones for daytime closures only.
11. Unless otherwise specified in the special provisions, a minimum of 3 cones shall be placed transversely across each closed lane and shoulder at each location where a taper across a traffic lane ends and every 2000' as shown on the "Lane Closure With Partial Shoulder Use" detail. Two Type II barricades may be used instead of the 3 cones. The transverse alignment of the cones or barricades on the closed shoulder may be shifted from the transverse alignment to provide access to the work.
12. Unless otherwise specified in the special provisions, the 1700' tangent shown along lane lines shall be used between the 1000' tapers required for each closed traffic lane.
13. A minimum of Two Type II barricades shall be placed across each closed lane and shoulder at the location shown and every 2000' within the complete closure area. Within the complete closure area, the transverse alignment of the barricades on the closed shoulder may be shifted from the transverse alignment to provide access to the work.
14. When specified in the special provisions, a W20-2 "DETOUR AHEAD" sign is to be used in place of the W20-3 "FREEWAY CLOSED AHEAD" sign.

SIGN PANEL SIZE (Min)

- A 48" x 48"
- B 48" x 18"
- C 48" x 30"

LEGEND

- Traffic Cone
- Temporary Sign
- Barricade
- Flashing Arrow Sign (FAS)
- FAS Support or Trailer
- Direction of Travel
- Portable Flashing Beacon

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

TRAFFIC CONTROL SYSTEM FOR LANE AND COMPLETE CLOSURES ON FREEWAYS AND EXPRESSWAYS

NO SCALE

T10A

9-28-05

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

Greg W. Edwards No. C36386 Exp. 6-30-06 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

To get to the Caltrans web site, go to: http://www.dot.ca.gov

TYPICAL LANE CLOSURE

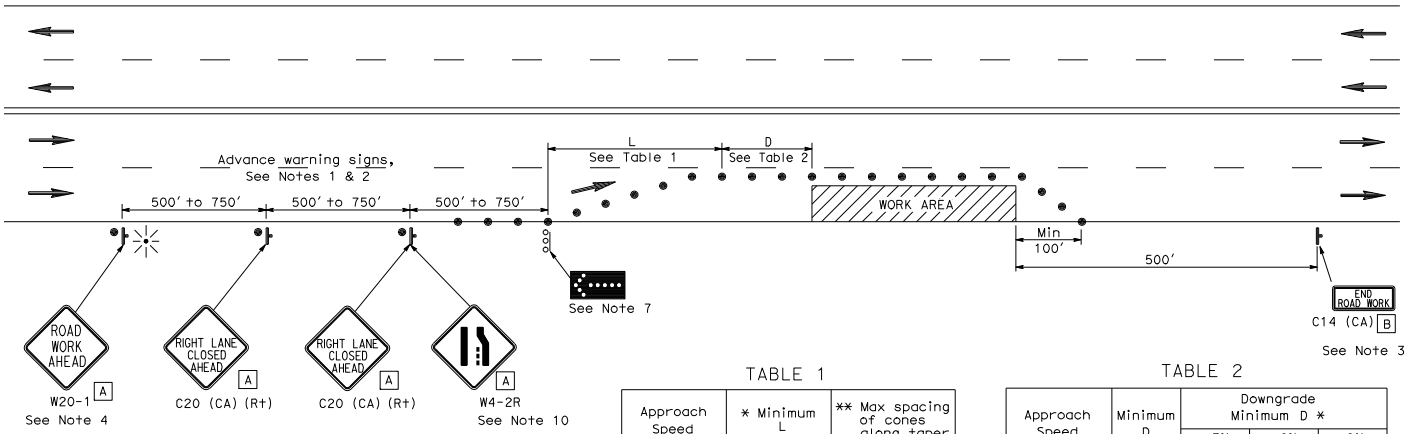


TABLE 1

Approach Speed	* Minimum L	** Max spacing of cones along taper
mph	ft	ft
20 and below	80	20
25	125	25
30	180	30
35	245	35
40	320	40
45	540	45
50	600	50
Over 50	See Note 9	

* Use L for lane widths less than or equal to 12′.
** See Note 8.

TABLE 2

Approach Speed	Minimum D	Downgrade Minimum D *		
		-3%	-6%	-9%
mph	ft	ft	ft	ft
25 and below	155	158	165	173
30	200	205	215	227
35	250	257	271	287
40	305	315	333	354
45	360	378	400	427
50	425	446	474	507
Over 50	See Note 9			

* Use on sustained downgrade steeper than -3 percent and longer than 1 mile.

NOTES:

Unless otherwise specified in the special provisions, all temporary warning signs shall have black legend on orange background.

California code are designated by (CA). Otherwise, Federal (MUTCD) codes are shown.

LEGEND

- Traffic Cone
- Temporary Sign
- Direction of Travel
- Flashing Arrow Sign (FAS)
- FAS Support or Trailer
- Portable Flashing Beacon

SIGN PANEL SIZE (Min)

A 36" x 36"
B 36" x 18"

NOTES:

1. Where approach speeds are low, advance warning signs may be placed at 300′ spacing and placed closer in urban areas.
2. Each advance warning sign shall be equipped with at least two flags for daytime closure. Each flag shall be at least 16" x 16" in size and shall be orange or fluorescent red-orange in color. Flashing beacons shall be placed at the locations indicated for lane closure during hours of darkness.
3. A C14 (CA) "END ROAD WORK" sign, as appropriate, shall be placed at the end of the lane closure unless the end of work area is obvious, or ends within a larger project's limits.
4. If the W20-1 sign would follow within 2000′ of a stationary W20-1 or C11 (CA) "ROAD WORK NEXT _____ MILES", use a C20 (CA) sign for the first advance warning sign.
5. All cones used for lane closures during the hours of darkness shall be fitted with retroreflective bands (or sleeves) as specified in the specifications.
6. Portable delineators, placed at one-half the spacing indicated for traffic cones, may be used instead of cones for daytime closures only.
7. Flashing arrow sign shall be either Type I or Type II.
8. The maximum spacing between cones along a tangent shall be 50′ and along a taper shall be approximately as shown in Table 1.
9. For approach speeds over 50 mph, use the "Traffic Control System for Lane Closure On Freeways And Expressways" plan for lane closure details and requirements.
10. When specified in the special provisions, a W4-2 "LANE ENDS" symbol sign is to be used in place of the C20 (CA) "RIGHT LANE CLOSED AHEAD" sign.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE ON MULTILANE CONVENTIONAL HIGHWAYS

NO SCALE

T11

9-28-05

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

Greg W. Edwards No. C36386 Exp. 6-30-06 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

To get to the Caltrans web site, go to: http://www.dot.ca.gov

LEGEND

- Traffic Cone
- Temporary Sign
- Direction of Travel
- Flashing Arrow Sign (FAS)
- FAS Support or Trailer
- Portable Flashing Beacon

TABLE 1

Approach Speed	* Minimum L	** Max spacing of cones along taper
mph	ft	ft
20 and below	80	20
25	125	25
30	180	30
35	245	35
40	320	40
45	540	45
50	600	50
Over 50	See Note 11	

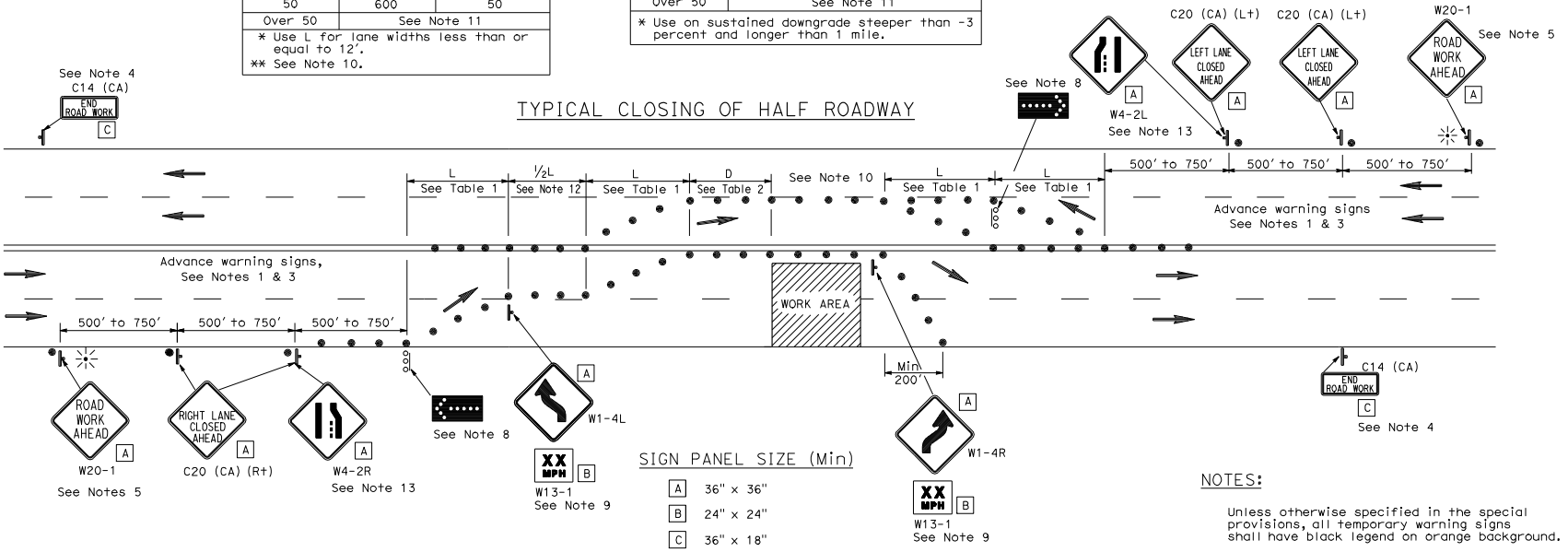
* Use L for lane widths less than or equal to 12'.
** See Note 10.

TABLE 2

Approach Speed	Minimum D	Downgrade Minimum D *		
		-3%	-6%	-9%
mph	ft	ft	ft	ft
25 and below	155	158	165	173
30	200	205	215	227
35	250	257	271	287
40	305	315	333	354
45	360	378	400	427
50	425	446	474	507
Over 50	See Note 11			

* Use on sustained downgrade steeper than -3 percent and longer than 1 mile.

TYPICAL CLOSING OF HALF ROADWAY



SIGN PANEL SIZE (Min)

- A 36" x 36"
- B 24" x 24"
- C 36" x 18"

NOTES:

Unless otherwise specified in the special provisions, all temporary warning signs shall have black legend on orange background.

California code are designated by (CA). Otherwise, Federal (MUTCD) codes are shown.

NOTES:

1. Where Approach speeds are low, advance warning signs may be placed at 300' spacing and placed closer in urban areas.
2. At least one person shall be assigned to provide full time maintenance of traffic control devices for lane closure unless, otherwise directed by the Engineer.
3. Each advance warning sign in each direction of travel shall be equipped with at least two flags for daytime closure. Each flag shall be at least 16" x 16" in size and shall be orange or fluorescent red-orange in color. Flashing beacons shall be placed at the locations indicated for lane closure during hours of darkness.
4. A C14 (CA) "END ROAD WORK" sign, as appropriate, shall be placed at the end of the lane closure unless the end of work area is obvious, or ends within a larger project's limits.
5. If the W20-1 sign would follow within 2000' of a stationary W20-1 or C11 (CA) "ROAD WORK NEXT _____ MILES", use a C20 (CA) sign for the first advance warning sign.
6. All cones used for lane closures during the hours of darkness shall be fitted with retroreflective bands (or sleeves) as specified in the specifications.
7. Portable delineators, placed at one-half the spacing indicated for traffic cones, may be used instead of cones for daytime closures only.
8. Flashing arrow signs shall be either Type I or Type II.
9. Advisory speed will be determined by the Engineer. The W13-1 Sign will not be required when advisory speed is more than the posted or maximum speed limit.
10. The maximum spacing between cones along a tangent shall be 50' and along a taper shall be approximately as shown in Table 1.
11. For approach speeds over 50 mph, use the "Traffic Control System For Lane Closure On Freeways And Expressways" plan for lane closure details and requirements.
12. Unless otherwise specified in the special provisions, the (½ L) shown between the two (L) lane closure tapers shall be used.
13. When specified in the special provisions, a W4-2 "Lane Ends" symbol sign is to be used in place of the C20 (CA) "RIGHT (LEFT) LANE CLOSED AHEAD" sign.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE ON MULTILANE CONVENTIONAL HIGHWAYS

NO SCALE

T12

10-3-05

NOTES:

Unless otherwise specified in the special provisions, all temporary warning signs shall have black legend on orange background.

California code are designated by (CA). Otherwise, Federal (MUTCD) codes are shown.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

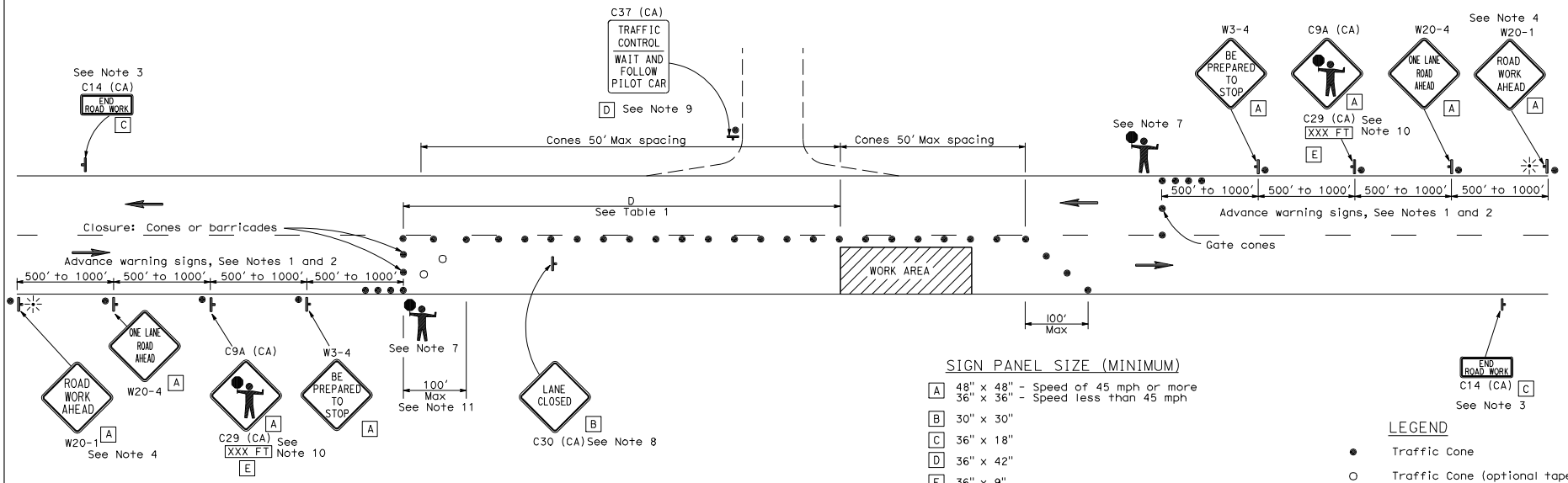
REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Greg W. Edwards — No. C36386 — Exp. 6-30-06 CIVIL — STATE OF CALIFORNIA

To get to the Caltrans web site, go to: http://www.dot.ca.gov

TYPICAL LANE CLOSURE WITH REVERSIBLE CONTROL



SIGN PANEL SIZE (MINIMUM)

- A 48" x 48" - Speed of 45 mph or more
  36" x 36" - Speed less than 45 mph
- B 30" x 30"
- C 36" x 18"
- D 36" x 42"
- E 36" x 9"

LEGEND

- Traffic Cone
- Traffic Cone (optional taper)
- Temporary Sign
- Direction of Travel
- Portable Flashing Beacon
- Flagger

NOTES:

1. Where approach speeds are low, advance warning signs may be placed at 300' spacing, and closer in urban areas.
2. Each advance warning sign in each direction of travel shall be equipped with at least two flags for daytime closure. Each flag shall be at least 16" x 16" in size and shall be orange or fluorescent red-orange in color. Flashing beacons shall be placed at the locations indicated for lane closure during hours of darkness.
3. A C14 (CA) "END ROAD WORK" sign, as appropriate, shall be placed at the end of the lane control unless the end of work area is obvious, or ends within a larger project's limits.
4. If the W20-1 sign would follow within 2000' of a stationary W20-1 or C11 (CA) "ROAD WORK NEXT _____MILES", use a W20-4 sign for the first advance warning sign.
5. All cones used for lane closures during the hours of darkness shall be fitted with retroreflective bands (or sleeves) as specified in the specifications.
6. Portable delineators, placed at one-half the spacing indicated for traffic cones, may be used instead of cones for daytime closures only.
7. Additional advance flaggers may be required. Flagger should stand in a conspicuous place, be visible to approaching traffic as well as approaching vehicles after the first vehicle has stopped. During the hours of darkness, the flagging-station and flagger shall be illuminated and clearly visible to approaching traffic. The illumination footprint of the lighting on the ground shall be at least 20' in diameter. Place a minimum of four cones at 50' intervals in advance of flagger station as shown.
8. Place C30 (CA) "LANE CLOSED" sign at 500' to 1000' intervals throughout extended work areas. They are optional if the work area is visible from the flagger station.
9. When a pilot car is used, place a C37 (CA) "TRAFFIC CONTROL-WAIT AND FOLLOW PILOT CAR" sign at all intersections within traffic control area. Signs shall be clean and visible at all times.
10. An optional C29 (CA) sign may be placed below the C9A (CA) sign.
11. Traffic cones or barricades may be placed on the optional taper as shown, barricades shall be Type I, II, or III.

TABLE 1

Approach Speed	Minimum D	Downgrade Minimum D *		
		-3%	-6%	-9%
mph	ft	ft	ft	ft
25 and below	155	158	165	173
30	200	205	215	227
35	250	257	271	287
40	305	315	333	354
45	360	378	400	427
50	425	446	474	507
55	495	520	553	593
60	570	598	638	686
65	645	682	728	785

* Use on sustained downgrade steeper than -3 percent and longer than 1 mile.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE ON TWO LANE CONVENTIONAL HIGHWAYS

NO SCALE

T13

9-28-05

TYPICAL RAMP CLOSURES

SIGN PANEL SIZE (Min)

- A 48" x 48"
- B 48" x 30"
- C 30" x 30"
- D 48" x 48" - Speed of 50 mph or more
  36" x 36" - Speed less than 50 mph
- E 48" x 36"

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

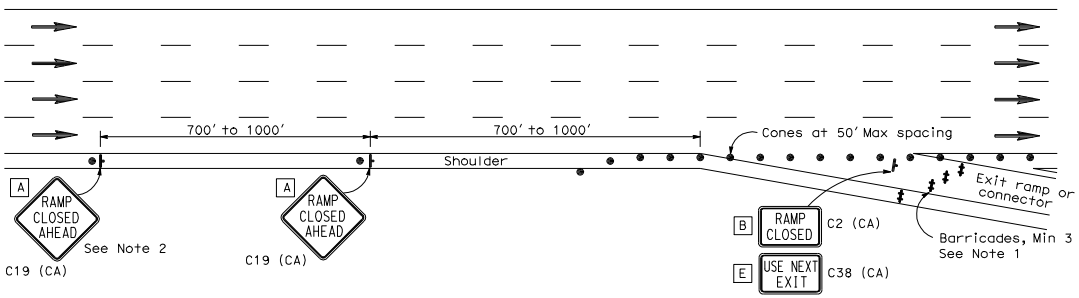
REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

Greg W. Edwards No. C36386 Exp. 6-30-06 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

To get to the Caltrans web site, go to: http://www.dot.ca.gov



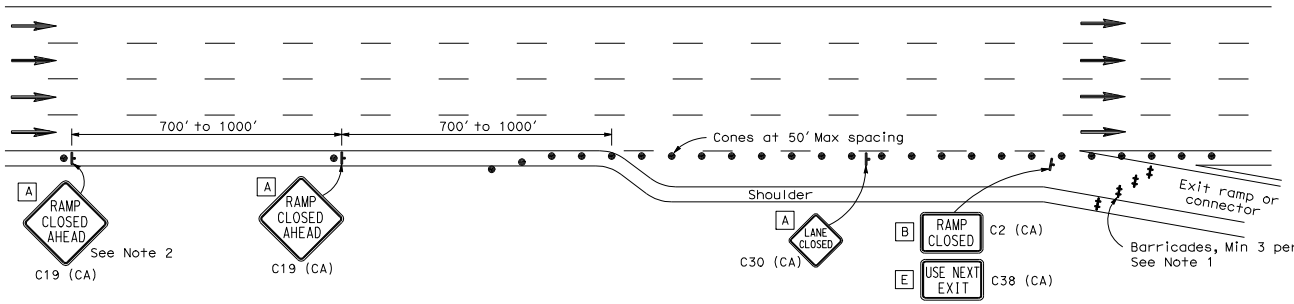
EXIT RAMP OR CONNECTOR

LEGEND

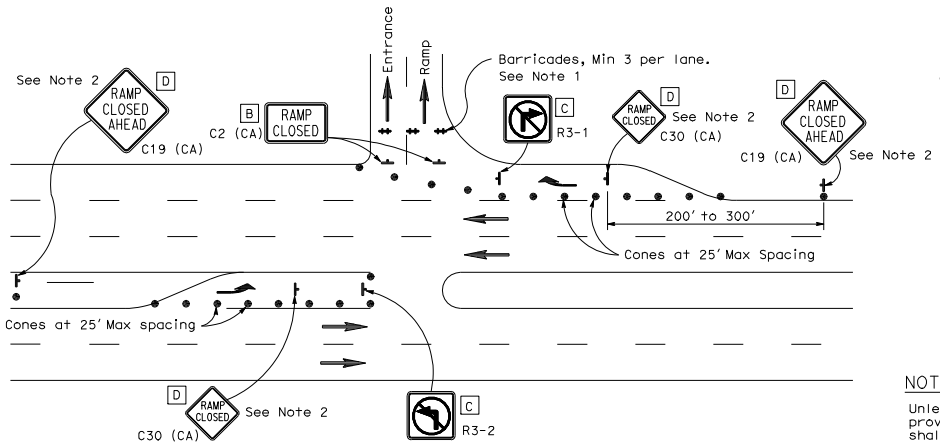
- Traffic Cone
- Temporary Sign
- Barricades
- Direction of Travel
- Turn Arrow

NOTES:

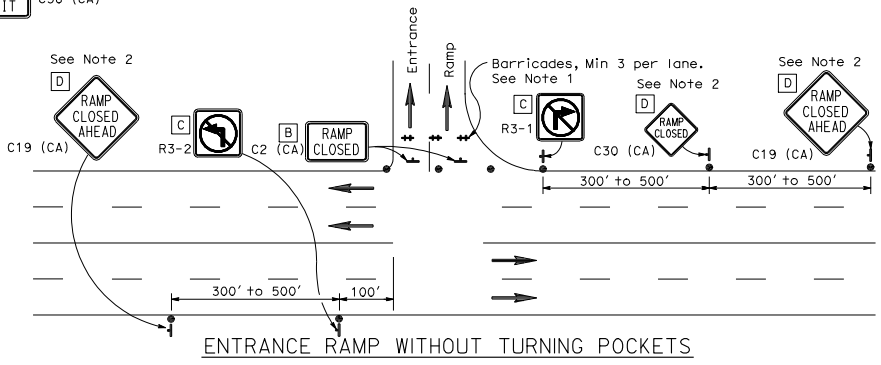
1. Barricades shall be Type I, II, or III for closures lasting one week or less and Type III for closures lasting longer than one week.
2. In addition to placing the C19 (CA) "RAMP CLOSED AHEAD" and C30 (CA) "RAMP CLOSED" signs, black on orange overlay plates with the word "CLOSED" may be mounted, as directed by the Engineer, on all guide signs that refer to the closed ramp. The letter size on the overlay shall be the same as the guide sign.
3. Each advance C19 (CA) "RAMP CLOSED AHEAD" sign shall be equipped with at least two flags for daytime closure. Each flag shall be at least 16" x 16" in size and shall be orange or fluorescent red-orange in color.
4. All cones used for ramp closures during the hours of darkness shall be fitted with retroreflective bands (or sleeves) as specified in the specifications.
5. Portable delineators, placed at one-half the spacing indicated for traffic cones, may be used instead of cones for daytime ramp closures only.
6. At least one person shall be assigned to provide full time maintenance of traffic control devices, unless otherwise directed by the Engineer.
7. The existing "EXIT" sign in the gore area shall be covered during ramp closures.



EXIT RAMP OR CONNECTOR WITH ADDITIONAL LANE



ENTRANCE RAMP WITH TURNING POCKETS



ENTRANCE RAMP WITHOUT TURNING POCKETS

NOTES:

Unless otherwise specified in the special provisions, all temporary warning signs shall have black legend on orange background.

California code are designated by (CA). Otherwise, Federal (MUTCD) codes are shown.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

TRAFFIC CONTROL SYSTEM FOR RAMP CLOSURE

NO SCALE

T14

9-28-05

2006 STANDARD PLAN T14

State of California

Business, Transportation and Housing Agency

Memorandum

To: ALL DISTRICT DIRECTORS

Attention Deputy District Directors
District Permit Engineers

Date: November 9, 1994

File No.: 617
Encroachment Permits

From: DEPARTMENT OF TRANSPORTATION
DIRECTOR'S OFFICE

Subject: Exception to Policy - Uncased High-pressure Natural Gas Pipeline Crossings

Encroachment Permits Manual Section 623, entitled "Transverse Boring and Jacking", requires that all new pipeline installations six inches and larger that cross a State highway must be placed within a casing that is bored and jacked under the highway.

Having examined the pros and cons of cased versus uncased natural gas transmission pipelines, Caltrans will now allow uncased natural gas pipeline crossings in specific circumstances. Because our primary concerns are for public safety, the integrity of the highway facility and the mechanical protection of the pipeline itself, it is necessary to limit requests for transverse natural gas transmission line crossings without casings to locations where the following conditions are met:

1) The pipeline owner agrees that the crossing will be designed for construction in accordance with the Code of Federal Regulations, Title 49, Part 192, and/or the California Public Utilities Commission General Orders No. 112-D with respect to natural gas pipelines. The crossing design shall be comprehensive in all respects including but not limited to material specification, pipe wall thickness determination, coating selection, and cathodic protection. Soil conditions at each site shall be analyzed for characteristics that may prove harmful to the protective pipe coating. This analysis shall be used by the pipeline owner in selecting a protective pipe coating sufficient to withstand the potential for gouging or peeling during the boring and jacking operation, or other methods approved by Caltrans. The final condition of the coating will be determined by the pipeline owner through monitoring of the boring and jacking operation, visually inspecting the exiting initial pipe segment, and electrical testing by an engineer or technician with expertise in cathodic protection. The test data shall be noted on the as-built drawings. Remedial action will be taken if the condition of the coating is such that cathodic protection is not practical.

2) The minimum depth of cover within State highway right of way, from the final ground line (finished grade or original ground) to the top of the proposed gas carrier pipeline, is two and one-quarter meters (7' - 6"). If the location is such that it is not practical to achieve the above depth of cover, then an engineered protective cover (such as a reinforced concrete structure) may be provided outside of pavement areas in lieu of casing. At

no time shall the minimum depth of cover be less than one and one-tenth meters (42").

3) The permit specifies that the uncased gas carrier pipeline shall, as a minimum, be designed for a Class 3 Location (Code of Federal Regulations referenced above) for hard surfaced roads, highways, public streets, and railroads. (See attached *Excerpts From Code of Federal Regulations, Design Factor to be Used for Natural Gas Pipelines*.)

4) The existence of the crossing is adequately identified by signing at the right-of-way line, with at least one identifying sign which is visible from the roadway in each direction of travel.

5) The pipeline owner agrees to provide as-built drawings at completion of the pipeline crossing, with a letter certifying that the pipeline was installed properly and in accordance with the permit plans (including approved changes to the permit plans), and meets industry and regulatory standards for such installation.

6) All other applicable requirements of Section 623 of the Encroachment Permits Manual are satisfied.

All permit applications requesting installations of such uncased natural gas pipeline crossings six inches or larger in diameter and meeting the above requirements may be approved by the highway district. All permit applications for uncased pipeline crossings deviating from the above requirements shall be submitted to the Chief of the Office of Project Planning and Design for exception approval in the usual manner.

R. P. WEAVER
Deputy Director
Project Development

JCHaggard:jl
bcc:
DHBenjamin
Attachment WPSmith
GPeck
JVan Berkel
DLeFevre
JHaggard
DParks - NTM&R
AGugino - Structures Maint.
WMorehead - Structures
PCotter - Structures
DHBenjamin's Pend
WPSmith's Pend
Director's Office Chron
Director's Office Read
OPPD File

EXCERPTS FROM CODE OF FEDERAL REGULATIONS ,

DESIGN FACTOR TO BE USED FOR NATURAL GAS PIPELINES

In the design of steel natural gas pipelines the Minimum Yield Strength for the grade of steel used is reduced by a Design Factor (F). This Design Factor is determined by the type of road being crossed by the pipeline and a Class Location established by Code of Federal Regulations, Title 49, Part 192 (Office of the Federal Register, 1990)

The Class Location depends on the occupancy of buildings or activities within an area that extends 660 feet (200 m) either side of the pipeline centerline for a continuous 1 mile (1.6 km) segment of the pipeline. There are four Class Locations as follows:

Class 1. Location that has 10 or less buildings intended for human occupancy.

Class 2. Location that has more than 10 but less than 46 buildings intended for human occupancy.

Class 3. a) Any location that has 46 or more buildings intended for human occupancy ; or

b) Area where pipeline lies less than 300 feet (91 m) of either a building or a small well-defined outside area (such as a playground, recreation area, outdoor theater, or other place of public assembly) that is occupied by 20 or more persons on at least 5 days a week fr 10 weeks in any 12-month period. (The days or weeks need not to consecutive).

Class 4. Location where buildings of four or more stories are prevalent.

The design factor used for a specific Class Location also depends on the kind of road involved as indicated on the following Table.

Design Factor (F)

	Class Location			
Kind of Thoroughfare	1	2	3	4
Privately owned roads	0.72	0.60	0.50	0.40
Unimproved public roads	0.60	0.60	0.50	0.40
Hard surfaced roads, highways public streets, and railroads	0.60	0.50	0.50	0.40

Example: A pipe made of X42 grade of steel which has a Minimum Yield Strength (MYS) of 42,000 psi used in a Class 4 location at a hard surface road crossing would be designed using a reduced Minimum Yield Strength, by applying a Design Factor of 0.4, of 16,800 psi.

CONTROLLED LOW STRENGTH MATERIAL

Controlled low strength material (CLSM) shall consist of a workable mixture of aggregate, cementitious materials, and water. Controlled low strength material shall conform to the provisions in Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications and these special provisions.

At the option of the Contractor, controlled low strength material may be used as structural backfill for pipe culverts within trenches.

When controlled low strength material is used for structure backfill, the width of the excavation shown on the plans may be reduced so that the clear distance between the outside of the pipe and the side of the excavation, on each side of the pipe, is a minimum of 6 inches except that 12 inches shall be required for pipes 42 inches and greater in diameter or span when height of cover is greater than 20 feet. Controlled low strength material shall not be used with underground structures having a span greater than 20 feet.

Controlled low strength material in new construction shall not be permanently placed higher than the basement soil. For trenches in existing pavements, permanent placement shall be no higher than the bottom of any existing pavement permeable drainage layer; if no drainage layer(s) are present, permanent placement in existing pavements shall be no higher than: a) 1 inch below the bottom of the existing asphalt concrete, or b) no higher than the top of base below existing Portland cement concrete pavements. When used, the minimum height that controlled low strength material placed relative to the pipe invert shall be: 0.5 d (diameter) for rigid pipe and 0.7 d for flexible pipe.

When controlled low strength material is proposed for use, the Contractor shall submit a mix design and test data to the Engineer for approval prior to excavating the trench for which controlled low strength material is proposed for use. The test data shall demonstrate that the mix design provides:

a) For pipe culverts having a height of cover of or less, a 28-day compressive strength between 50 and 100 psi is required; for height of cover greater than 20 feet, a minimum 28-day compressive strength of 100 psi is required. Compressive strength shall be determined by ASTM Test Method D4832, "Preparation of Testing of Soil-Cement Slurry Test Cylinders."

b) When controlled low strength material is used as structure backfill for pipe culverts, the sections of pipe culvert in contact with the controlled low strength material shall meet the requirements of Chapter 850 of the Highway Design Manual using the minimum resistivity, pH, chloride content, and sulfate content of the hardened controlled low strength material. Minimum resistivity and pH shall be determined by California Test 643, the chloride content shall be determined by California Test 422, and the sulfate content shall be determined by California Test 417.

c) Cement shall be: any type of Portland cement conforming to the provisions of ASTM Designation C 150; any type blended hydraulic cement conforming to ASTM C 595M; or any type blended hydraulic cement conforming to the physical requirements of ASTM C 1157M. Testing will not be required.

d) Admixtures may be used in conformance with Section 90-4 of the Standard Specifications and the following: Chemical admixtures containing chlorides as CI in excess of 1 percent by mass of admixture, as determined by California Test 415, shall not be used.

Materials for controlled low strength material shall be thoroughly machine-mixed in a pugmill, rotary drum, or other approved mixer. Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Controlled low strength material shall be placed in the work within 3 hours after mixing.

Controlled low strength material shall be placed in a uniform manner that will prevent voids in, or segregation of, the backfill, and will not float or shift the culvert. Foreign material that falls into the trench prior to or during placing of the controlled low strength material shall be immediately removed.

When controlled low strength material is to be placed within the traveled way or otherwise to be covered by paving or embankment materials, it shall achieve a maximum indentation diameter of 3 inches prior to covering and opening to traffic. Penetration resistance shall be as measured by ASTM Test Method C 6024, "Standard Test Method for Ball Drop on Controlled Low Strength Material to Determine Suitability for Load Application."

Controlled low strength material used as structure backfill for pipe culverts will be considered structure backfill for compensation purposes.